Iron and Manganese Removal Facilities for Group B Water Systems

Submittal Outline

This outline is intended to guide and summarize your design of iron (Fe) and manganese (Mn) treatment facilities for Group B water systems using groundwater sources.

Various surveys of iron and manganese treatment facilities in the USA have shown that only 50 to 60 percent of the facilities produced water that met drinking water standards for iron (Fe) and manganese (Mn). The following factors may affect treatment and should be considered when designing a treatment facility.

- The oxidation pH is too low.
- The effective size of the filtration media is too large.
- The oxidation time is too short.
- Lack of accurate raw water analysis at time of design.
- Incorrect oxidant dosage applied.
- Filtration rate is too high.
- Inadequate backwashing leading to filtration media failure.

I. Raw Water Quality

A minimum of two separate measurements should be performed for the following water quality parameters. Temperature, ferrous iron and pH measurements must be performed at the well site (not in a lab). All other water quality parameters should be analyzed by a laboratory certified for drinking water analysis.

Raw Water Quality Table

Water Quality Parameters	#1	#2	Method/Test Used	Calibration
Sample Date/Time			N/A	N/A
Ferrous Iron (Fe^{+2}) [mg/l]				
Total Iron [mg/l]				
Manganese [mg/l]				
Hardness [mg/l of CaCO3]				
Alkalinity [mg/l of CaCO3]				
TOC [mg/l]				
Temperature [Celsius]				
Sulfate [mg/l]				

Silica [mg/l]				
Total Phosphate [mg/l]				
pH				

II. Type of Treatment Option Chosen

Indicate the type of treatment proposed:

☐ Ion Exchange / Water Softener
☐ Chlorine (as an oxidant) and Filtration
☐ Potassium Permanganate and Filtration (Manganese Greensand Filter)

III. Treatment System Details

Provide a written description of the proposed treatment plant with specifications. Include an appropriately labeled diagram. The description should include flow rates, chemical doses needed, facility size, and how backwash or regeneration will be accomplished (if applicable).

IV. Ion Exchange (if applicable)

1. Resins
   a. Describe the type of resin.
   b. Explain your choice of resins.
   c. Provide the resin manufacturer's information.
   d. Confirm the resins are NSF approved (Standard 61).
   e. Indicate whether cleaning compounds will be used. If so, provide the name of the compound, and confirm the NSF listing (Standard 60).

2. Treatment Rate
   a. Specify the maximum flow rate to be treated in gpm (attach pump curve).
   b. Identify the manufacturer's recommended treatment unit application rate.
   c. What is the area of treatment unit(s) proposed in (sq.ft)?
   d. What is the actual application rate (max flow / area) in gpm/sq.ft? Verify that the actual application rate ≤ recommended maximum?
   e. Verify that the system hydraulics provide adequate flow and pressure downstream of the proposed treatment unit(s).

3. Backwash and Regeneration (applicable to Ion Exchange)
   a. Describe a backwash cycle including backwash initiation (head loss, timer), backwash rate, frequency, length of backwash, backwash mechanism (such as source of water, air scour), quantity of wastewater, and disposal of wastewater.

b. Identify the manufacturer's recommended backwash application rate in gpm/sq.ft. Is the actual backwash rate ≥ recommended rate?

c. Identify the backwash pump pressure in psi. Attach pump curve. Verify adequacy of system hydraulics for the proposed backwash.

d. Verify that no cross connection exists between the backwash source water and the wastewater.

e. Describe the regeneration process, including the triggers to start and stop regeneration.

f. Describe how the regeneration solution is made.

4. Backwash/regeneration disposal

   a. Describe the contents, average day, and peak day volume of backwash/regeneration.

   b. Describe disposal of backwash/regeneration, and include all backwash disposal facilities in construction documents.

   c. Confirm that you have consulted with Ecology and the local health department, and that the proposed method of backwash/regeneration waste disposal is acceptable to them both.

V. Filtration Process

1. Filter Media

   a. Identify the components of the filter media and the manufacturer's name.

   b. Attach a copy of NSF 61 approval.

2. Filter Rate

   a. Specify the maximum flow rate to be treated in gpm (attach pump curve).

   b. Identify the manufacturer's recommended treatment unit application rate in gpm/sq.ft? (Must be less than 5 gpm/sq.ft).

   c. What is the area of treatment unit(s) proposed in (sq.ft)?

   d. What is the actual application rate (max flow / area) in gpm/sq.ft? Verify that the actual application rate ≤ maximum recommended rate?

   e. Verify that the system hydraulics provide adequate flow and pressure downstream of the proposed treatment unit(s).

3. Backwash Process

   a. Describe the backwash cycle including backwash initiation (head loss, timer), backwash rate, frequency, length of backwash, backwash mechanism (such as source of water, air scour), quantity of wastewater, and disposal of wastewater.

   b. Identify the manufacturer's recommended backwash application rate in gpm/sq.ft. (Should be greater than 12 gpm/sq.ft). Is the actual backwash rate ≥ recommended?

   c. Identify the backwash pump pressure in psi. Attach pump curve. Verify adequacy of system hydraulics for the proposed backwash.

d. Verify that no cross connection exists between the backwash source water and the wastewater.

4. Oxidant (if applicable)

   a. Provide feed pump and solution tank specifications, including capacity, compatibility with oxidant, and operational controls (if any).

   b. Demonstrate the feed pump is capable of providing the proper dose of oxidant through all ranges of flow to the filter. Reference source of information to determine proper oxidant dose.

   c. Describe how the oxidant is mixed and prepared for injection.

   d. Describe contact time requirements and contact time provided through the full range of flow from oxidant injection to the filter vessel. Reference volume of contact tank or contact pipe.

   e. Sizing chemical feed pump:

$$Qf = \frac{(Qs)(Cs)(60)}{Cf} = \_\_\_ \; gal/hr$$

   Qs = Maximum system flow rate, gpm

   Cs = Desired oxidant dose, ppm

   Cf = Proposed feed solution concentration, ppm

   Qf = Capacity of chemical feed system, gph

5. pH Adjustment (if applicable)

   a. Describe the need for pH adjustment.

   b. If adding chemicals, attach sizing calculations per oxidant section above.

   c. If a contact bed (e.g., limestone contactor) is used, describe materials, time to deplete bed capacity at design flow rates and pH.

6. Regeneration (applicable to Manganese Greensand Filtration)

   a. Describe the regeneration process, including the triggers to start and stop regeneration.

   b. Describe how the regeneration solution is made.

   c. Attach sizing calculations per oxidant section above.

7. Backwash disposal

   d. Describe the contents, average day, and peak day volume of backwash.

   e. Describe disposal of backwash, and include all backwash disposal facilities in construction documents.

   f. Confirm that you have consulted with Ecology and the local health department, and that the proposed method of backwash waste disposal is acceptable to them both.

VI. System Hydraulics

1. Describe source-pumping mode (pumps directly to storage or to distribution).
2. Define the current installed source pumping capacity in gpm.
3. Verify that the installed pumping capacity is adequate to meet design standards with the proposed treatment on line. Discuss all components of the total pumping head (well pump lift, system elevation difference, treatment plant head loss, system head losses, and residual pressure).

VII. Operations and Maintenance

1. Prepare an O&M manual section, which includes:
   a. Identify maintenance personnel and operators.
   b. Outline routine inspection and maintenance - daily, weekly, monthly, annually.
   c. Identify major equipment components and their manufacturers.
   d. Identify a record keeping system to track treatment system performance.
2. Miscellaneous
   a. Sampling taps for both raw and finished water and after each treatment unit.
   b. Totalizing meter to record total volume treated.
   c. Flow proportioned feed pump(s), if needed.
   d. Solution tank covered and volume calibrated.
   e. Fe and Mn test kits in specifications.